

Gabriel Lozano-Bergeres^{1,2*}, Ángel Matute-Llorente^{1,2}, Alejandro Gómez-Bruton^{1,2}, Jorge Marín-Puyalto^{1,2},
Alejandro González-Agüero^{1,2}, Germán Vicente-Rodríguez^{1,2}, José A. Casajús^{1,2}

¹GENUD (Growth, Exercise, Nutrition and Development) Research Group, University of Zaragoza, Zaragoza, Spain
²Centro de Investigación Biomédica en Red de Fisiopatología de la Obesidad y Nutrición (CIBEROBN)
*E-mail: glozano@unizar.es

Introduction

Among the different methods of calculating body-fat percentage (BF%), the use of anthropometric equations is the most economic and accessible. Furthermore, several studies have used anthropometry in young soccer players¹. However, it has not been studied yet which anthropometric equation is the most accurate for estimating BF% in children and adolescent soccer players.

Therefore, the aim of this study was to determine whether the commonly used anthropometric equations or a new developed specific equation are adequate to estimate BF% in adolescent soccer players.

Methods

Ninety-eight players (65 males / 33 females; 13.4 ± 0.6 years) from different Spanish soccer clubs participated in the present study. Following the recommendations of the International Society of the Advancement of Kinanthropometry (ISAK), biceps, triceps, subscapular, supraspinale, iliac-crest, abdominal, front thigh and medial calf skinfolds were measured and inserted in the following prediction equations to estimate BF%: Johnston et al., Slaughter et al., Carter et al., Faulkner et al. and Deurenberg et al. Dual energy X-ray absorptiometry (DXA) was used as a reference method to evaluate BF%. Several 2-paired samples t-tests were used to compare BF% from DXA and the different equations. The validity and presence of heteroscedasticity of these equations was assessed by Bland-Altman analyses. Stepwise linear regression was used to develop the soccer-specific equation. A cross-validation for the new anthropometric equation was performed using Stein's equation.



The developed equation resulted as follows:

$$BF\% = 11.115 + 0.775 * (\text{triceps skinfold, mm}) + 0.193 * (\text{iliac-crest skinfold, mm}) - 1.606 * (\text{sex})$$

(sex=0 for female; sex=1 for male)

All previous anthropometric equations showed significant differences in comparison to DXA (p < 0.05). Moreover, all equations underestimated the BF% calculated by DXA. However, the proposed equation demonstrated high cross-validation prediction power (R²=0.85).

Table 1. Linear regression analysis and the coefficient of determination by Stein of each proposed equation in adolescent soccer players.

Model	R	R square	R square adjusted	SEE	R ² Stein
1	0.907	0.824	0.822	2.44	0.82
2	0.918	0.843	0.839	2.31	0.83
3	0.925	0.856	0.851	2.22	0.85

Dependent variable: whole body percentage of body fat; independent variables: sex, biceps, triceps, subscapular, iliac-crest, supraspinale, front thigh and medial calf skinfolds. SEE: standard error estimation
Model 1: (constant), triceps skinfold thickness
Model 2: (constant), triceps, iliac-crest skinfold thickness
Model 3: (constant), triceps, iliac-crest skinfold thickness, sex

Conclusion

The specific equation developed in the present study may be the most appropriate for estimating BF% in adolescent soccer players.

Acknowledgments

The authors want to thank all the children, their parents and soccer clubs (Real Zaragoza S.A.D.; Los Molinos U.D.; C.D. Marianistas and S.D. Ejea) that participated in the study for their understanding and dedication to the project. This work was supported by the Spanish Ministry of Economy and Competitiveness (Project DEP 2012-32724). GLB received a Grant FPU 2013 (FPU13/02111) from the Spanish Ministry of Education, Culture and Sport.

References

¹Lago-Penas, C., et al.(2011). Anthropometric and physiological characteristics of young soccer players according to their playing positions: relevance for competition success. J Strength Cond Res, 25(12), 3358-3367.

